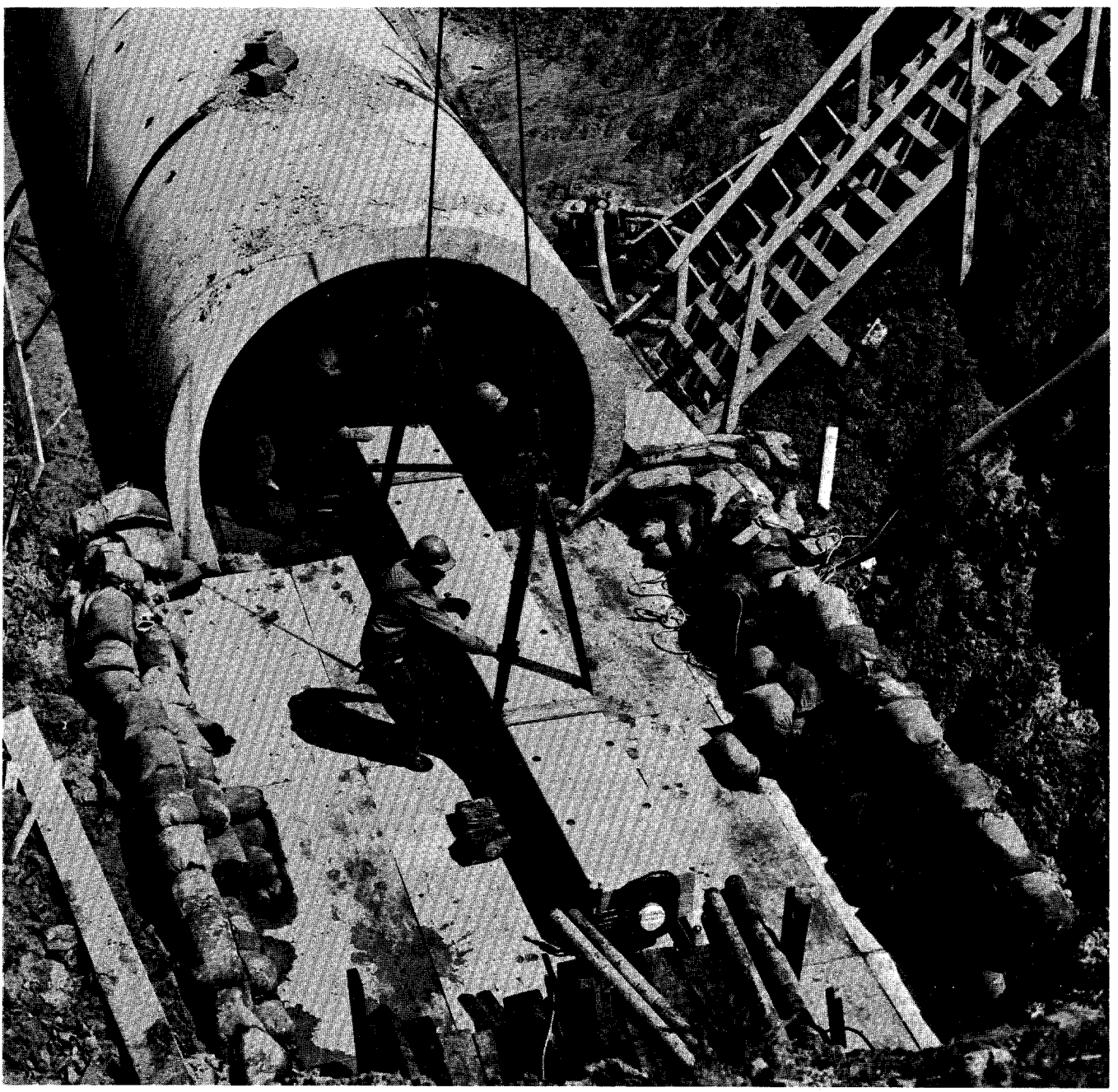
national accelerator laboratory FERMILAB-NAL-041

MONTHLY REPORT OF ACTIVITIES

April 30, 1970



FIRST MAGNET GOES INTO MAIN RING

Operated by Universities Research Association Inc. Under Contract with the United States Atomic Energy Commission

MONTHLY REPORT OF ACTIVITIES

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April 30, 1970

Abstract: This report summarizes the activities of the National Accelerator Laboratory in April, 1970.

General

1. Schedule and Energy. At the annual Users Meeting on April 10 and 11, R. R. Wilson announced that, with continuing good luck, it is now possible that we will have an accelerated proton beam by mid-1971, a year earlier than the originally scheduled date. It also appears possible that a few protons can be accelerated to an energy of 500 BeV not long after the synchrotron is brought into operation.

Wilson's complete statement is included as an appendix to this report.

2. Construction Progress.

a. Booster. The West Gallery of the Booster was occupied by the Laboratory in April. The entire contract is 86% complete; it should be noted that considerable piping and bus-duct installation work has been added to this contract and the contract has therefore been extended. This piping and duct work is almost completed and installation of cable trays and other supply lines is starting. An aerial view of the work is shown in Fig. 1.

b. Utility Plant. Erection of the steel framework has been completed. Several major pieces of the heating equipment have been delivered and are

being installed. Work on excavating the booster cooling pond has begun, as can be seen in Fig. 1. (The pond inadvertently went well ahead of its

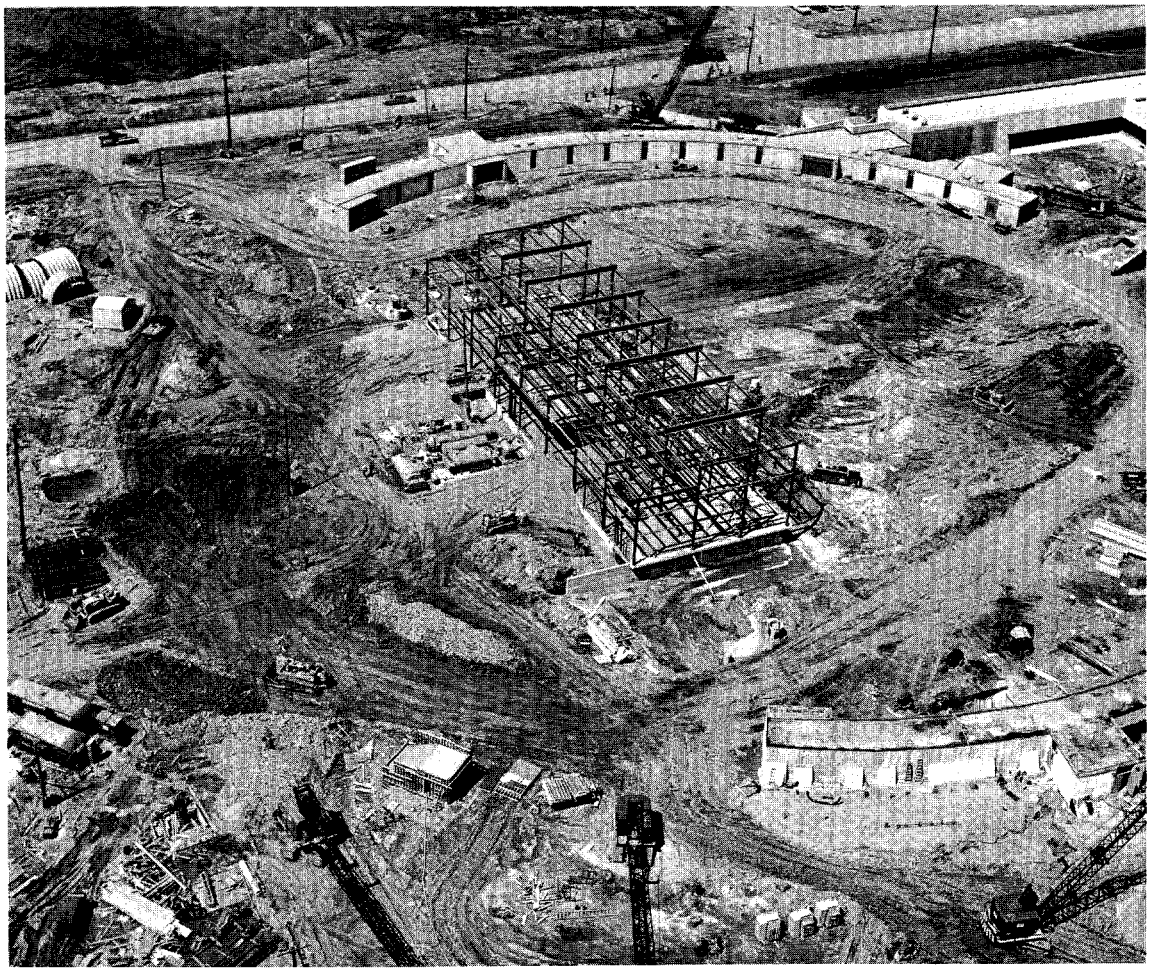

Fig. 1. Steel frame of the Utility Plant. The Booster West Gallery and the Linac are beyond; the end of the East Gallery is in the foreground.

scheduled filling date during heavy rains on April 30; unfortunately, the tunnel was also inundated.) The contract is 21% complete.

c. Main Accelerator.

(i) Phase I. Figure 2 shows the progress. Backfilling over the tunnel is in progress. Work on the vehicle access building and on the first service building has also started.

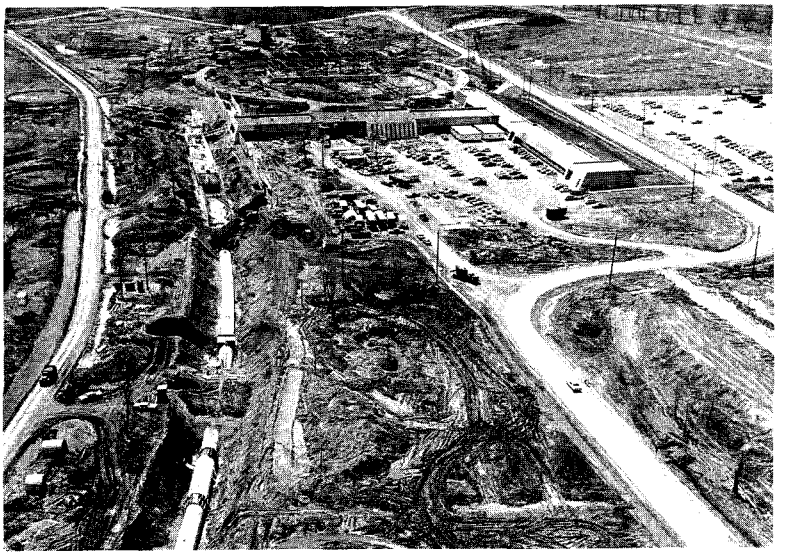

Fig. 2. Progress of work on the main ring. The Transfer Hall and Injection Area are in the distance. Road A is at the right and the Ring Road at the left. The excavation for the first Vehicle Access is at the far end of the Transfer Hall. The excavation inside the ring just this side of the two utility poles is the beginning of the first service building.

The earth "plug" between the Transfer Hall and the tunnel has been removed. Figure 3 shows work on the Transfer Hall itself, where backfilling has also begun. The contract is 59% complete.

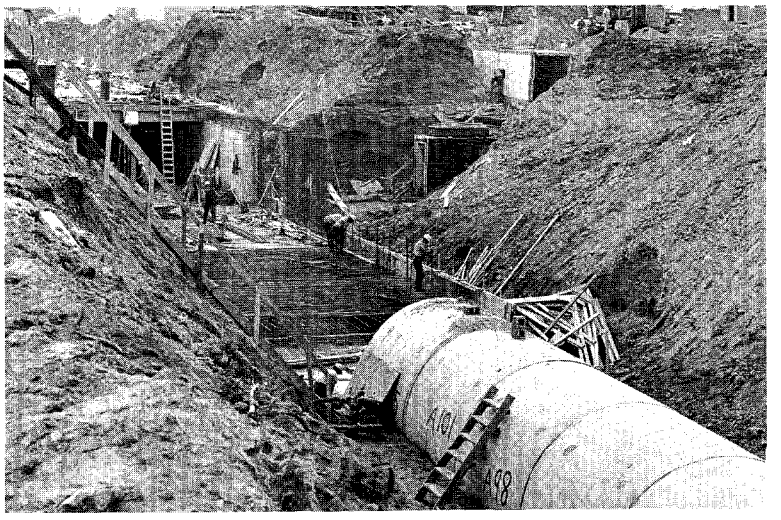

Fig. 3. Downstream end of the Transfer Hall. This is the point at which the first magnet was brought into the tunnel. The end of the Transfer Gallery can be seen at the right.

(ii) Phase II. The contractor has carried out several thousand feet of excavation and a large number of precast tunnel forms. An incentive contract has been worked out to give earlier occupancy of the RF building at long straight section F, which is needed to meet the advanced schedule. The Phase II contract is 14% complete.

d. Cross Gallery. This work can also be seen in Fig. 2. Interior work is proceeding on schedule. The contract is 87% complete.

e. Industrial Buildings. The Laboratory occupied the first building on April 20. The second building is now closed in. This contract is 76% complete.

f. Master Substation. The steel framing is virtually complete. The contract as a whole is 40% complete.

3. Appointments. Donald Edwards has been appointed Controls Manager (after a remarkably short tenure by his predecessor). He will coordinate the control-system work of the individual sections and will be in charge of the work on central controls.

4. Equal Opportunity. A new group of young men has gone to Oak Ridge National Laboratory for technical training. Figure 4 shows them at the airport. Upon completion of their training, they will join the Laboratory.

A substantial contract for main-accelerator magnet-lamination stamping and core assembly has been awarded to the Sanderson Co. of inner-city Chicago, a minority-owned fabricator.

Linac

Figure 5 shows Tank 2 leaving the Village in route to the permanent building. Figure 6 shows the tank in the linac tunnel. Since the tank

Fig. 4. Men leaving for technical training at Oak Ridge.

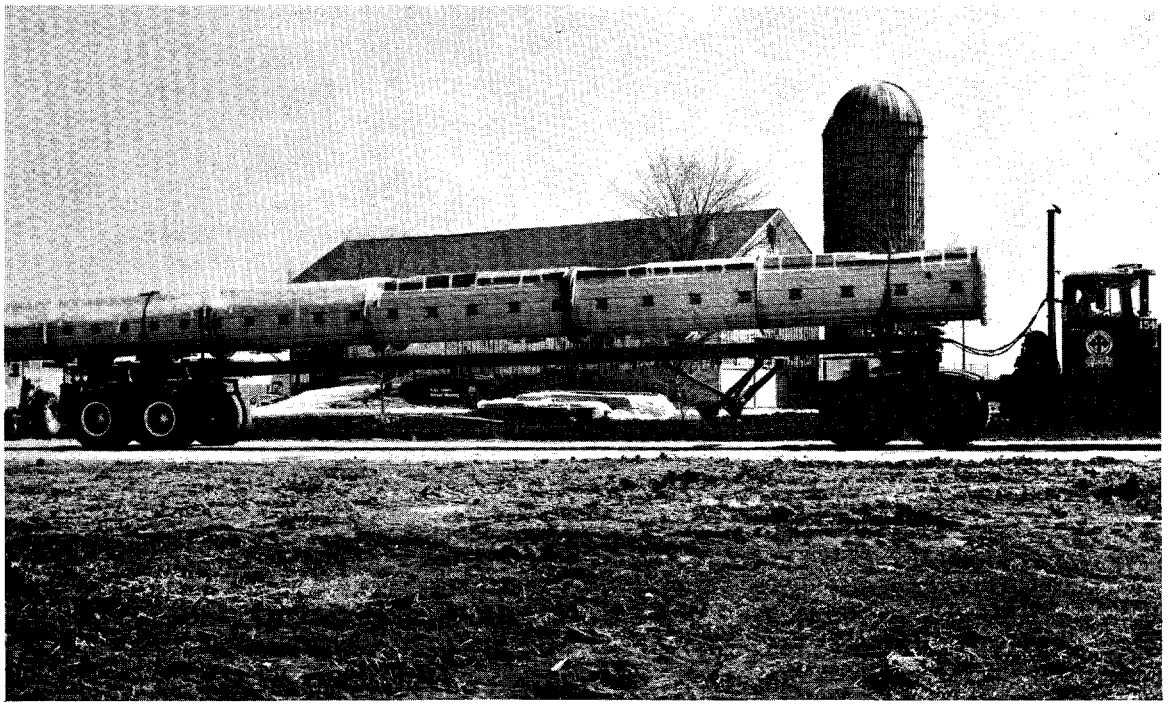

Fig. 5. Linac tank 2 leaving the Village. The barn behind was the site of the Users Meeting the same day.

installation on April 10, 24 of the 61 drift tubes and some of the post couplers have been installed. The rf system for this tank is also complete, except for late delivery of the filament-supply voltage regulator.

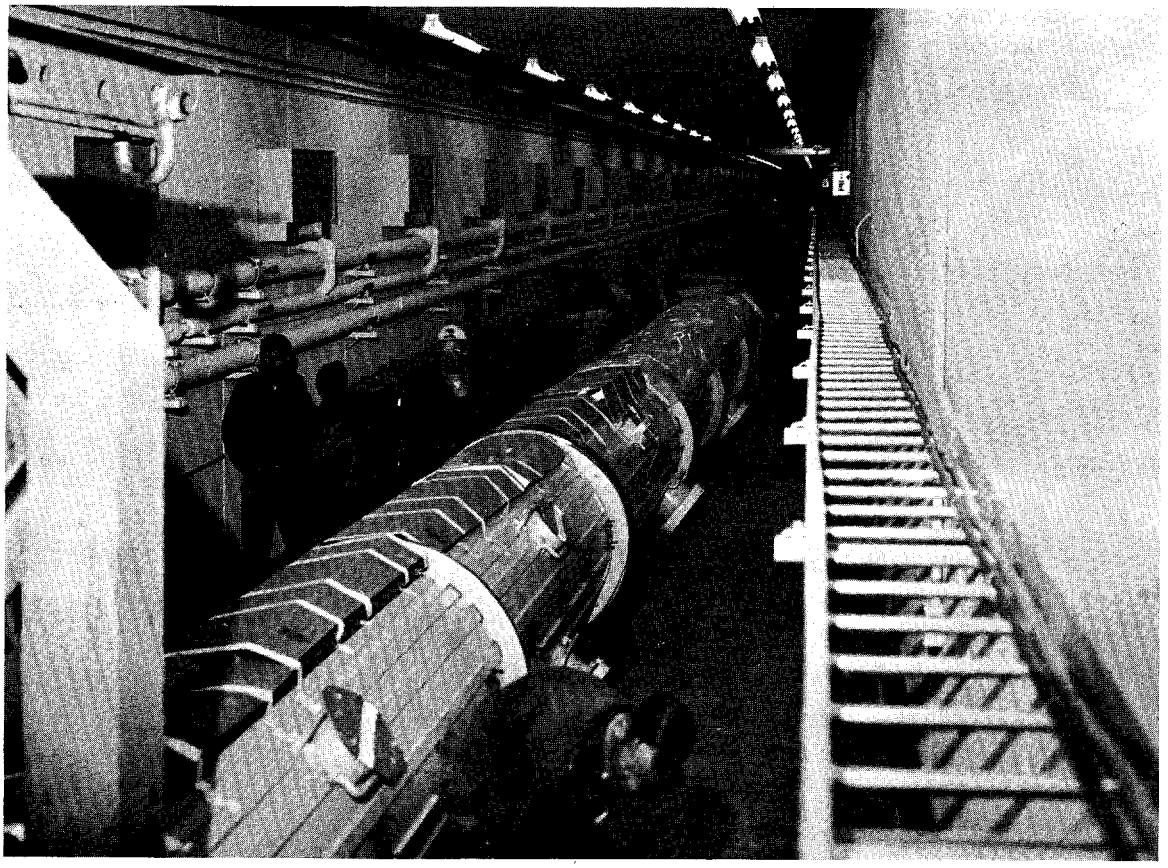

Fig. 6. Tank 2 being installed in the Linac Building.

Five additional tank sections (each tank has three sections) have been delivered and are being assembled in the Village.

Another significant milestone was achieved on April 17, when 10-MeV beam was achieved with the permanent system. This event involved successful operation of the new preaccelerator, new ion-source electronics, a completely rebuilt rf system, a new cooling system, and many new elements in the control system.

Booster

Equipment is being installed in the West Gallery. Cable installation in the tunnel will start as soon as tray installation is far enough along.

Figure 7 shows the work in the Booster Laboratory in the Village.

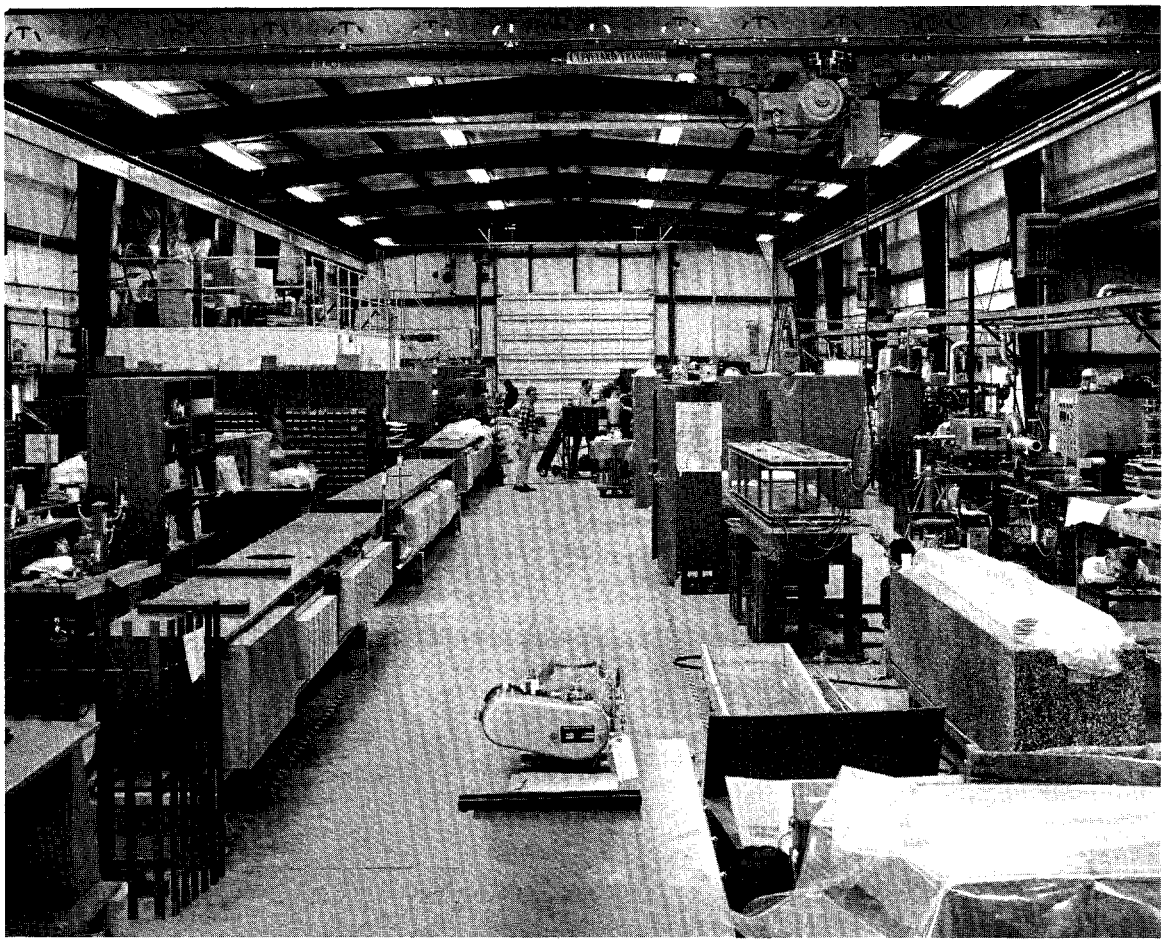

Fig. 7. Work in the Booster Laboratory. Girders with chokes and capacitors installed are at the left. Magnets are stacked at the far end, where Will Hanson and others are standing.

Several completed magnets are being installed on girders. Very good production magnet end packs are now being received.

Main Accelerator

The first B2 bending magnet was installed in its position in the

main-ring tunnel on April 15. The vehicle access is not yet ready, so the magnet was lowered to the tunnel level by crane.

Magnet cores and outer coils are being delivered from the fabricators. The West Chicago facility is producing one inner coil per day; additional equipment is being procured to increase this to the steady-state rate of four per day. Options have been exercised for additional outer coils from the fabricators.

Contracts have been awarded for power-supply thyristors and for complete power-supply units. A sufficient quantity has been ordered for excitation to 500 BeV. Contracts have also been awarded for water-distribution and power-piping distribution busses.

Beam Transfer

Tests are in progress on the target-box system. Figure 8 shows an equipment bedplate and the railroad transporter car. The alignment tests

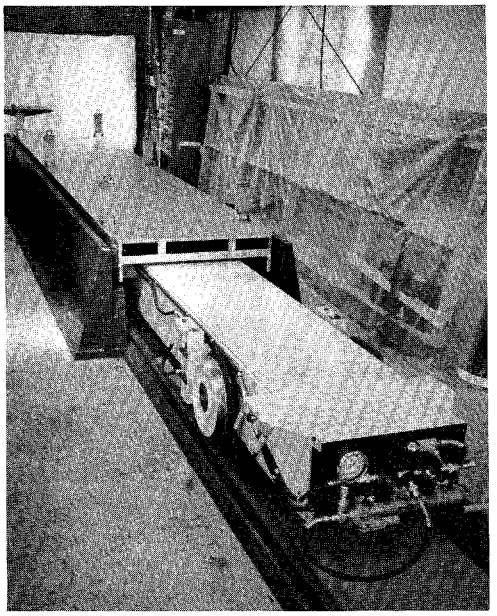

Fig. 8. Target vacuum box, partly disassembled. The equipment bedplate is at the top and the transporter has been partly brought out.

have shown that the system makes it possible to position equipment within a repeatable error of a few thousands of an inch. Full-load tests are now under way.

Experimental Facilities

Plans for Experimental Areas 1 and 2 were presented and discussed at the Users Meeting. Figure 9 is a sketch of the present layout of these experimental areas.

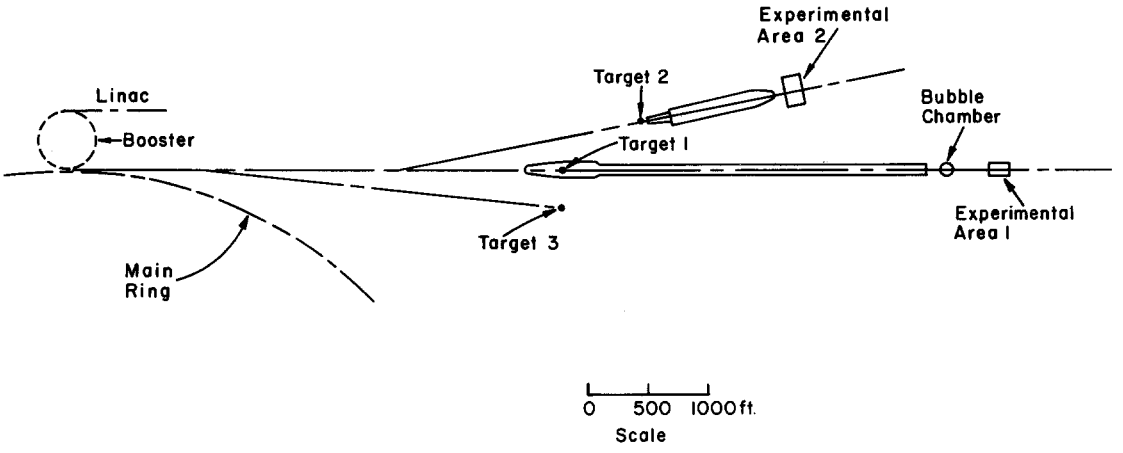

Fig. 9. Plan of experimental areas. Area 2 now is west of area 1. It crosses the corner of the Master Substation near the junction of Roads A and B. Area 1 is straight ahead along the external proton-beam line. Area 3 will be designed later.

Area 2 has been moved from a position south of Area 1 to the other side, in order to provide more space in it. The beams in Area 2 are designed for a variety of purposes and will eventually include an attenuated proton beam, two high-energy secondary beams, a medium-energy secondary beam, and two neutral beams. These beams will be contained inside an earth shield to reduce the muon background to a permissible level. The beams will

then emerge into an experimental hall at the end of the shield. The first beams in Area 2 will be ready for use in 1972. In order not to delay this area, it will be designed for a maximum proton energy of 200 BeV.

Experimental Area 1 will contain more-specialized beams. The major element will be a high-energy neutrino beam. It will be used in a 15-foot bubble chamber that will be constructed by the Laboratory at the end of the shield and in counter arrays beyond the bubble chamber. Muons in the same beam will also be used in these counter arrays. A high-energy rf-separated beam will run parallel to the neutrino beam to the bubble chamber. This experimental area is planned for initial use by January, 1973. It is designed for maximum proton energies of 500 BeV.

The first part of the proton-beam enclosure is farther along in design than the rest of the areas. Its construction will be separately contracted and is scheduled to start early this summer.

APPENDIX

Statement made by R. R. Wilson at the second annual meeting of the NAL Users Organization on Friday, April 10, 1970.

Construction of the synchrotron at the National Accelerator Laboratory is on, and in some cases, ahead of schedule. It now appears possible to have an accelerated proton beam by mid-1971, a year earlier than the originally scheduled date and considerably before the experimental areas and the rest of the Laboratory are completed. It also appears possible that the protons can be accelerated to an energy close to 500 BeV at reduced intensity not long after the synchrotron is brought into operation.

This advance in the schedule and increase in energy has come in spite of the fact that funding for construction has become available more slowly than the optimum rate projected in our design report. In fact it has been in response to the reduced rate of funding that internal schedules have been rearranged by postponing construction of some parts of the Laboratory. We have also been able to move rapidly because actual bids on many components and structures have been low, which is a measure of the simplifications that have been made in the design. Almost all the accelerator components and structures have been purchased, but the experimental areas and laboratories have not.

Our main-accelerator design has included from the start the capibility of extending the proton energy from 200 to 400 and perhaps to 500 BeV. Recent tests on production magnets have made it clear that they will be good

up to field levels corresponding to 500 BeV. Furthermore, the technology of thyristors, which are used as rectifiers in the power supply, has been advanced considerably. This and other technical developments have made it possible to install from the beginning a power supply adequate for 500 BeV at smaller cost than was originally estimated for 200 BeV.

The cooling capability that is being installed corresponds to year-round operation at 200 BeV with the design intensity of 1.5×10^{13} protons per second. Operation at higher energies will mean choosing cooler days or lowering the repetition rate. The average intensity at 500 BeV will probably be down by one or two orders of magnitude. Nevertheless, there are exploratory experiments that can be carried out and it is expected that some experiments will begin as soon as possible, making use of whatever facilities are available. It is expected that at a later date a greater capacity for cooling, deposition of radiation, and correction for loading of the electrical services will be added.

The first area for electronic detector experiments is presently projected to come on in July, 1972. It will be limited to 200 BeV, in order not to delay it. The second area is projected for completion by January, 1973, and will provide a neutrino beam for weak-interaction experiments,a bubble chamber for use in the study of both weak and strong interactions and will be designed for incident protons with energies up to 500 BeV.

Any attempt to predict an exact date and energy of the initial operation is hazardous; as better information is forthcoming, the expected date will be corrected. Great effort and continuing good luck will be required to meet the advanced schedule.